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From: Jamie Michael Kern <jamiekern@gmail.com>
Sent: Thursday, May 29, 2014 8:30 AM
To: RBurns-Web; Burns-Web; BitterSmith-Web; Pierce-Web; Stump-Web
Subject: as per Commissioners Burns and Burns' request: US energy subsidy info
Attachments: What-Would-Jefferson-Do-Final-Version - The Historical Role of Federal Subsidies in Shaping America's Energy Future - DBL.pdf

Good morning, Commissioners,

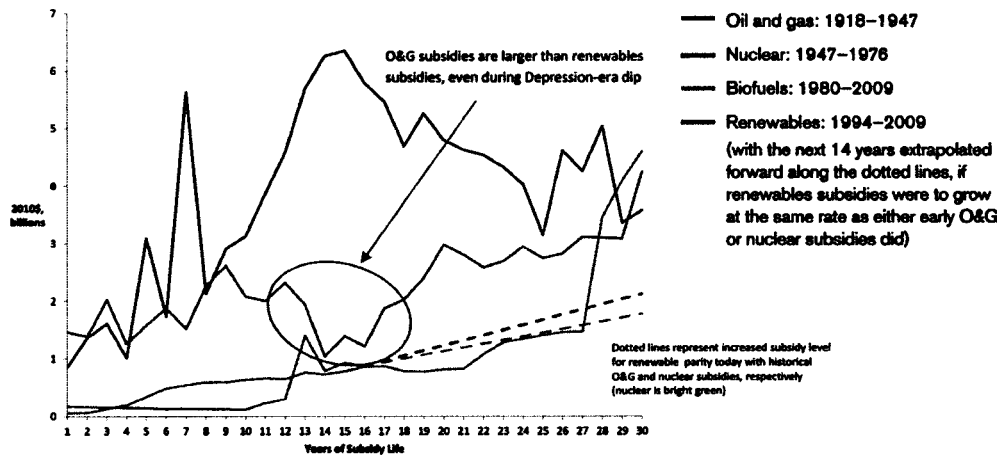
ORIGINAL

In yesterday's ACC Workshop on Emerging Technologies, one of the presenters mentioned government subsidies for non-renewable energy sources. Commissioner Bob Burns said he was interested in learning more about these, and Brenda Burns echoed that sentiment.

For those unfamiliar with fossil-fuel subsidies, the numbers can seem implausible at first. But both massive tax breaks and cash incentives have driven nearly all sectors of our economy for over a century.

The attached DBL Investors report has some excellent graphs and charts depicting all US energy subsidies over their first 30 years. Its executive summary states, "the federal commitment to [oil and gas] was five times greater than the federal commitment to renewables during the first 15 years of each subsidies' life, and it was more than 10 times greater for nuclear."

Comparison of Early Federal Subsidies to Energy Sectors



Arizona Corporation Commissioner
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What exactly are these fossil fuel subsidies? The OECD lists many of them in its comprehensive Inventory of estimated budgetary support and tax expenditures for fossil fuels (very large PDF here). They include:

- Alternative Fuels Production Credit (for natural gas, shale oil, coke, coal...)
- Refined Coal Credit
- Indian Coal Credit
- Capital Gains Treatment of Royalties on Coal
- Partial Expensing for Advanced Mine Safety Equipment
- Expensing of Exploration and Development Costs
- Excess of Percentage over Cost Depletion

- Amortisation of Geological Expenditure
- Accelerated Depreciation of Natural-Gas Distribution Pipelines
- Exception from Passive Loss Limitation
- Temporary Expensing of Equipment for Refining
- Aid to Small Refiners for EPA Capital Costs
- Enhanced Oil Recovery Credit
- Qualified Capital Expenditure Credit
- Development Credit for Certain Producers
- Alternative Credit for Exploration
- Alaska Gasline Inducement Act
- Sales Tax Exemption for Oil & Gas Equipment
- Sales-Tax Exemption for Natural Gas
- Severance Tax Exemptions for Crude Oil
- Severance Tax Exemptions for Natural Gas
- Gasoline Tax Exemptions
- Exclusion of Low-Volume Oil & Gas Wells
- Coalbed Methane Exemption
- Reduced Tax for Thin-Seamed Coal
- Credit for Investment in Clean Coal
- Fossil Energy R&D

Some of those oil and gas subsidies, and others, are detailed here.

But by far the single greatest energy subsidy in the US, currently over \$13 billion, was established for the nuclear power industry with the Price-Anderson Act. In brief: since no private institution nor free market could ever insure a catastrophic nuclear incident, the federal government does so instead - at zero cost to the power plant developer and owner.

And while that may sound like a large subsidy, it is only one tenth (1/10) of the amount that Tepco needed from its government for the Fukushima fallout. Much of that is decommissioning costs, which are also not included in the cost of a nuclear plant (and therefore not rate-based until the plant shutters).

If you've gotten this far, thank you for reading. My only point is this: the word "subsidy" has been used and abused - without adding any value to the discussion - by all parties involved. The easiest (and only) way to proceed is to ignore the extent to which an energy source is subsidized, accept that no "free market" for US energy exists, and simply make sound decisions based on the current economic and social climate. In such a case, public interest takes priority.

Sincerely,

Jamie Michael Kern

What Would Jefferson Do?

The Historical Role of Federal Subsidies
in Shaping America's Energy Future

BY Nancy Pfund AND Ben Healey

SEPTEMBER 2011



DBL INVESTORS
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Some argue that the consumer can purchase warmth or work or mobility at less cost by means of coal or oil or nuclear energy than by means of sunshine or wind or biomass. The argument concludes that this fact, in and of itself, relegates renewable energy resources to a small place in the national energy budget. The argument would be valid if energy prices were set in perfectly competitive markets. They are not. The costs of energy production have been underwritten unevenly among energy resources by the Federal Government.

— August 1981 report of the DOE
Battelle Pacific Northwest National Laboratory

Executive Summary

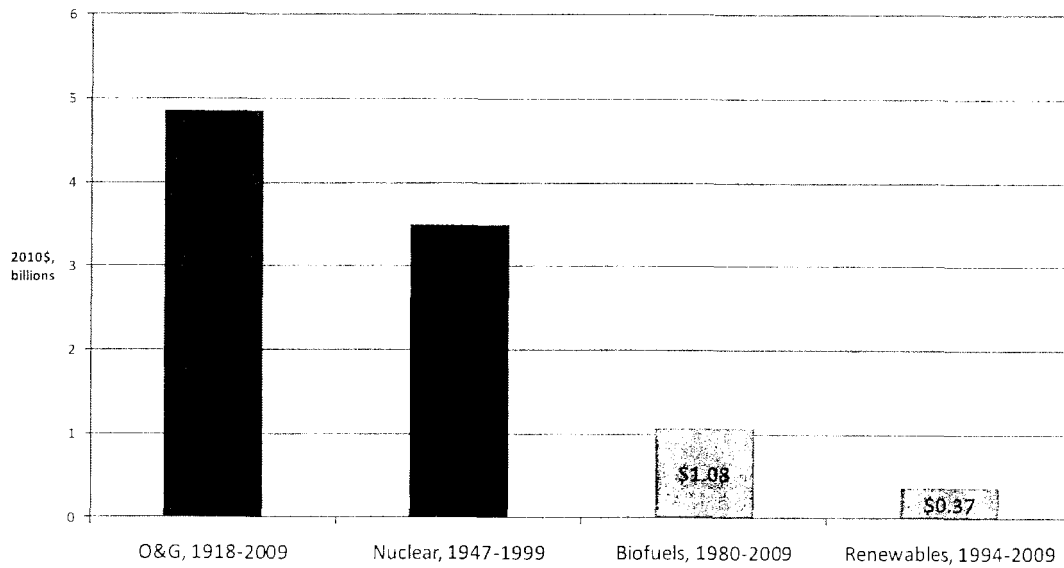
This paper frames the ongoing debate about the appropriate size and scope of federal subsidies to the energy sector within the rich historical context of U.S. energy transitions, in order to help illuminate how current energy subsidies compare to past government support for the sector. From land grants for timber and coal in the 1800s to tax expenditures for oil and gas in the early 20th century, from federal investment in hydroelectric power to research and development funding for nuclear energy and today's incentives for alternative energy sources, America's support for energy innovation has helped drive our country's growth for more than 200 years.

Using data culled from the academic literature, government documents, and NGO sources, in this paper we examine the extent of federal support (as well as support from the various states in pre-Civil War America) for emerging energy technologies in their early days. We then analyze discrete periods in history when the federal government enacted specific subsidies. While other scholars have suggested that the scope of earlier subsidies was quite large, we are—as far as we know—the first to quantify exactly how the current federal commitment to renewables compares to support for earlier energy transitions. Our findings suggest that current renewable energy subsidies do not constitute an over-subsidized outlier when compared to the historical norm for emerging sources of energy. For example:

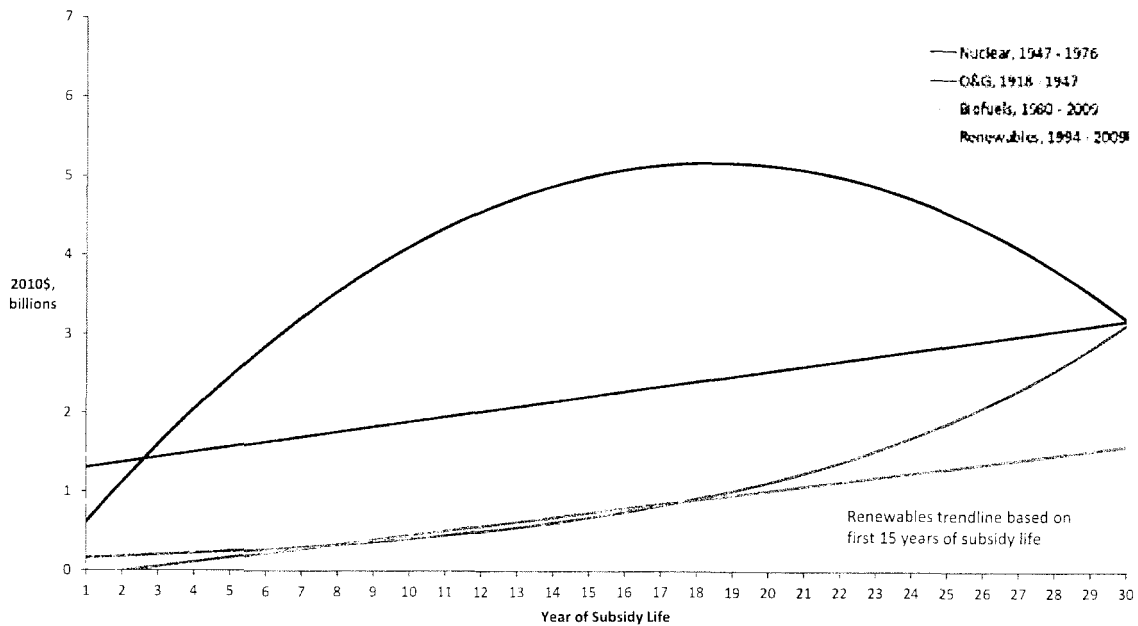
- As a percentage of inflation-adjusted federal spending, nuclear subsidies accounted for more than 1% of the federal budget over their first 15 years, and oil and gas subsidies made up half a percent of the total budget, while renewables have constituted only about a tenth of a percent. That is to say, the federal commitment to O&G was five times greater than the federal commitment to renewables during the first 15 years of each subsidies' life, and it was more than 10 times greater for nuclear.
- In inflation-adjusted dollars, nuclear spending averaged \$3.3 billion over the first 15 years of subsidy life, and O&G subsidies averaged \$1.8 billion, while renewables averaged less than \$0.4 billion.

The charts below clearly demonstrate that federal incentives for early fossil fuel production and the nascent nuclear industry were much more robust than the support provided to renewables today.

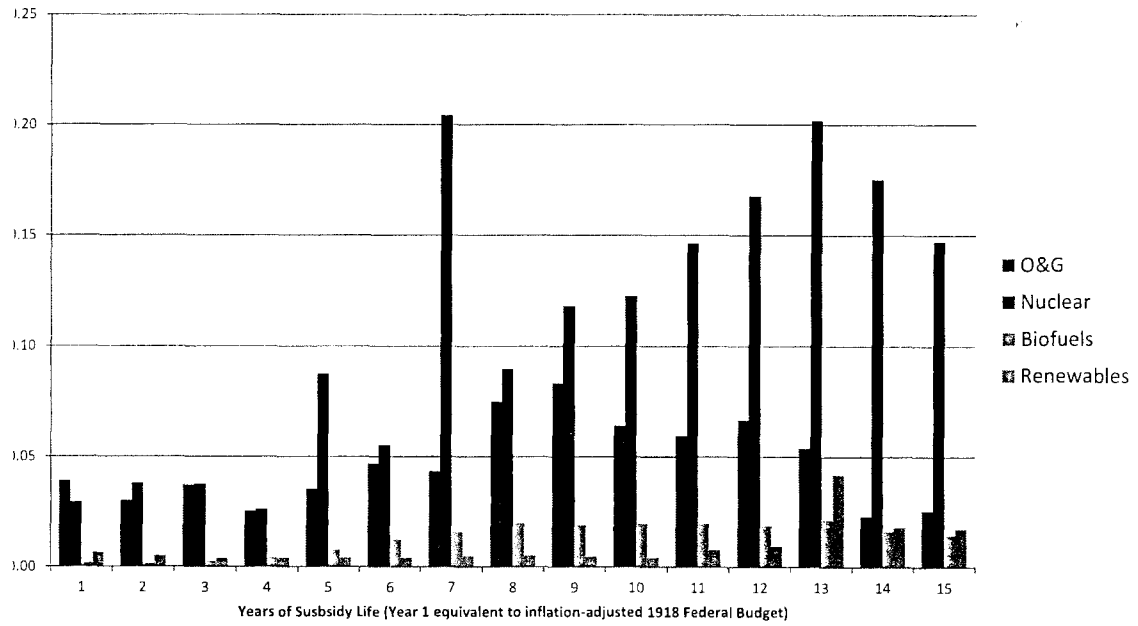
Historical Average of Annual Energy Subsidies: A Century of Federal Support



Comparative Energy Subsidy Trends



Energy Subsidies as Percentage of Federal Budget



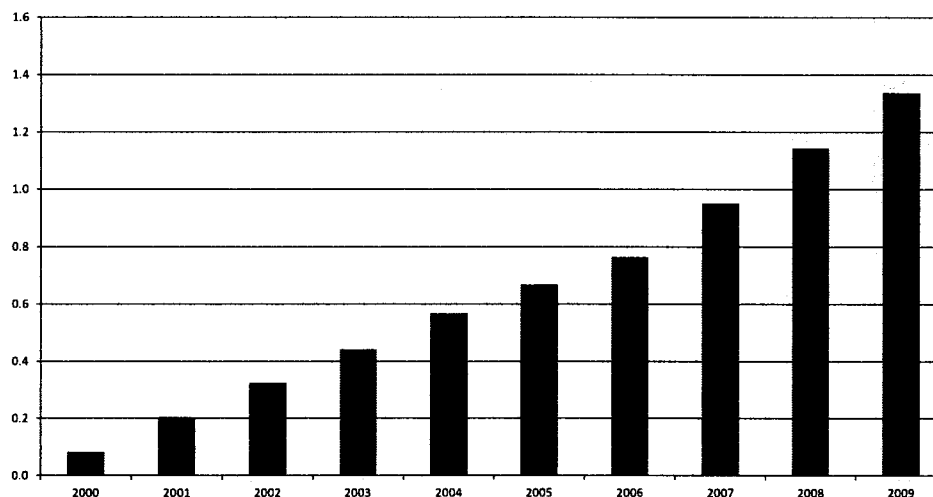
Introduction

Over the course of decades, contentious debates have raged in Washington, DC about the appropriate size and scope of federal subsidies to the energy sector, including support for both traditional fossil fuel industries and the emerging renewable energy sector. Certainly, a quick survey of existing subsidies demonstrates that critics have plenty of legitimate reasons to complain. Take the capital gains treatment of royalties on coal as an example. This subsidy allows owners of coal mining rights to reclassify income traditionally subject to the income tax as royalty payments, thereby allowing owners to pay a reduced tax rate:

In 1950 and 1951, Congress increased a number of taxes to pay for the United States' entry into the Korean War. With prevailing 1951 marginal income tax rates ranging up to a high of 91 percent and capital gains tax rates at 25 percent regardless of income, the reclassification was primarily adopted to insulate certain owners of coal mining rights from high marginal income tax rates ... thus encouraging additional production. Since then, both income and capital gains tax rates for individuals have fallen, and the capital gains tax rate for individual owners currently stands at 15 percent. However, the credit is still available to members of the coal industry.¹

This subsidy totaled well over \$1.3 billion in government tax expenditures from 2000 – 2009:

Cumulative Capital Gains Treatment of Royalties on Coal, 2000–2009
(2010\$, BILLIONS)



Source: Joint Committee on Taxation

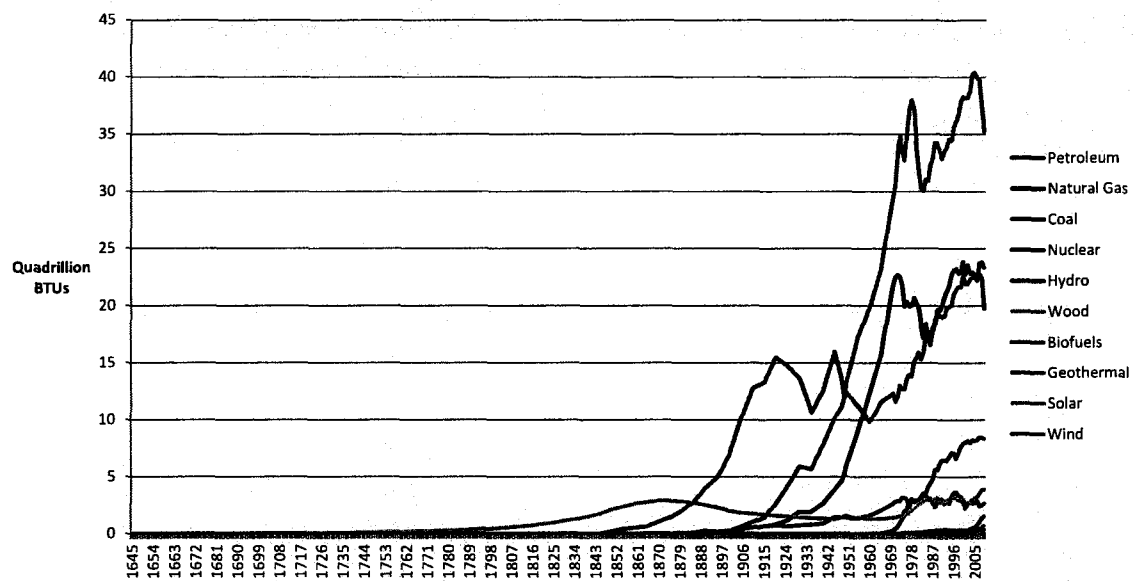
¹ David Sher, Environmental and Energy Study Institute, "Fossil Fuel Subsidies: A Closer Look at Tax Breaks, Special Accounting, and Societal Costs" (June 2011).

True, this Korean War-era tax break seems grossly out of place in the 21st century, but not all subsidies are created equal. Historically, policymakers have justified intervention in energy markets “1) to promote a new technology during the early developmental stages and 2) to pay the difference

between the value of an activity to the private sector and its value to the public sector.”² Thus, it is worth evaluating our current energy subsidies through a longer historical lens, so that we can better understand how current incentives compare to past government support for the energy sector.

U.S. Growth and Historical Energy Transitions

Primary U.S. Energy Consumption



Source: Energy Information Administration

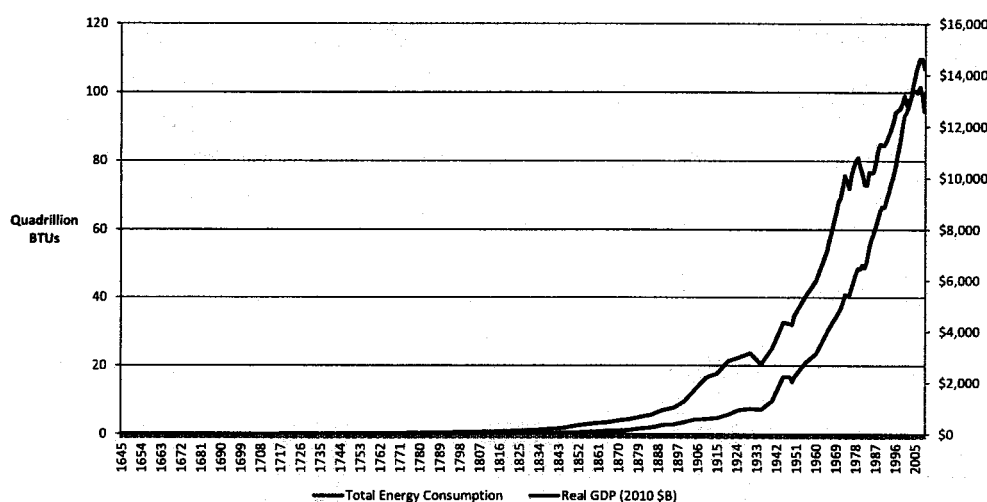
² Mona Hymel, Arizona Legal Studies Discussion Paper No. 06-15, "Americans and Their 'Wheels': A Tax Policy for Sustainable Mobility" (February 2006).

We can read the history of the United States—our country’s geographic and economic expansion—through the history of our energy production and consumption. Through war and peace, through westward expansion and our rise to economic and military superpower status, we find that energy transitions fueled it all. Wood and small hydro powered our country’s early, rural days. As cities expanded, railroads crisscrossed the nation, and the Industrial Revolution took hold, coal dominated. With the invention and improvement of the internal combustion engine, oil catapulted into our preeminent fuel. Large hydro became a reality thanks to Depression-era initiatives that have continued to drive economic development programs across the country decades later, followed by nuclear power on the heels of World War II. And today, in pursuit of greater energy security, enhanced environmental quality and economic growth on a globalized playing

field, renewable energy sources are transitioning from the margins to the mainstream. As the chart below starkly illuminates, our wealth and our energy usage are intimately intertwined.

Energy innovation has driven America’s growth since before the 13 colonies came together to form the United States, and government support has driven that innovation for nearly as long. In this paper, we identify specific government interventions in the energy sector during moments of transition, and we attempt to quantify that support in order to compare it to current support for emerging renewable sources of energy. Although most of our quantitative analysis focuses on federal support, it is important to note that states have also contributed to the American energy narrative throughout our history, from the support of coal in the 19th century to incentives for renewable energy production 200 years later, and we will not ignore the role of the various states in the discussion that follows.

Primary U.S. Energy Consumption vs. GDP



Source: Energy Information Administration and MeasuringWorth

Overall, what we find, in contrast to much of today's headline-grabbing rhetoric, is that today's government incentives for renewable energy pale in comparison to the kind of support afforded emerging fuels during previous energy transitions.

Look back to the 1700s:

From Battelle National Lab – “The first recorded commercial coal transaction in the United States was a 32-ton shipment from the James River district in Virginia to New York in 1758.”³

...Into the 1800s:

From Stanford's Center for International Security and Cooperation – “As a pamphleteer wrote in 1860, a year after Uncle Billy Smith struck oil at Oil Creek in Titusville, Pennsylvania, ‘Rock oil emits a dainty light, the brightest and yet the cheapest in the world; a light fit for Kings and Royalists and not unsuitable for Republicans and Democrats.’”⁴

From the Renewable Energy Policy Project – “The first attempt to transport natural gas on a large scale was in Rochester, New York in 1870. A 25-mile line was constructed of hollowed pine logs. It was a failure.”⁵

...Through the 1900s:

From Greenpeace – “In December, 1953, President Eisenhower inaugurated an ‘Atoms for Peace’ [nuclear energy] program that... would ultimately swallow the lion's share of federal dollars for energy research.”⁶

3 R.J. Cole, et. al., DOE Battelle Pacific Northwest Laboratory, “An Analysis of Federal Incentives Used to Stimulate Energy Consumption” (August 1981).

4 Richard Rhodes, Stanford University Center for International Security and Cooperation, “Energy Transitions: A Curious History” (September 19, 2007). Rhodes is a Pulitzer Prize-winning journalist and historian.

5 Marshall Goldberg, Renewable Energy Policy Project, “Federal Energy Subsidies: Not All Technologies are Created Equal” (July 2000).

6 Komanoff Energy Associates, Greenpeace, “Fiscal Fission: The Economic Failure of Nuclear Power” (December 1992).

Timber and Coal in the 19TH Century

Although we think of today's subsidies in terms of tax policy, government research and development initiatives, or direct spending on behalf of an industry, the 19th century had its own vehicle of public support: land. From the Preemption Act of 1841 to the Homestead Act of 1862 to the Timber and Stone Act of 1878, it was official policy of the early U.S. government to make land grants to its citizens at below-market prices in order to encourage settlement, expansion, and economic development. Rather than actual land, though, government policy took the form of distributing warrants for land ownership, which industry representatives often purchased at a discount. According to one historian:

The land, including natural resources, constituted an enormous stock of assets available for transfer. As a rough estimate of the order of magnitude, the land transfers were tantamount to an annual deficit of about 30 percent of the latter 19th century annual federal budgets. [In total,] over 13.5 million acres of timber land was alienated, amounting to four-fifths of the forest domain.⁷

Of course, it would be inappropriate to consider these land grants as subsidies solely to the timber industry in and of itself. If we conservatively estimate, however, that only 5% of these massive

land grants subsidized the use of timber, and that only half of that amount was actually for energy purposes, still it would amount to about a 25 billion-dollar a year energy subsidy, as an equivalent percentage of today's federal budgets. This estimate does not even include indirect support for the timber industry though land grants to the railroads: "As early as the mid-nineteenth century, logging operations were highly capital intensive, requiring spur railroad lines and other equipment to handle the huge logs of the virgin forests."⁸

A Native American Approach to Subsidies:

Indeed, the notion of awarding special control over key natural resources to those considered best positioned to develop them was not true solely of western expansionists: several Native American traditions restrict tribal access to key plants and trees used in basket-making to selected apprentices and allow only certain elders and other respected elites to actually make the baskets. One might consider this role the "oil refining" of this particular natural supply chain.⁹

⁷ Fred E. Foldvary, Southern Economic Association Meetings, "Ground Rent Seeking in U.S. Economic History" (November 21, 1997).

Foldvary is a lecturer in economics at Santa Clara University.

⁸ Gary D. Libecap and Ronald N. Johnson, *The Journal of Economic History* Vol. 39, No. 1, "Property Rights, Nineteenth-Century Federal Timber Policy, and the Conservation Movement" (March 1979).

⁹ Lois Conner (Yokuts basketmaker) and Ruby Pomona (Mono Elder) presentation on June 7, 2011 at the "Trails of Fire: Signatures of Cultural and Environmental Transformations on the American and Australian Frontiers," conference at Stanford University held June 6-9, 2011.

Early support for coal did not lag far behind timber:

Each state had its own energy policy—which, taken together, created a highly fragmented and somewhat chaotic regulatory regime that encouraged the production and consumption of vast quantities of coal. Nature made coal abundant; public policy made it cheap.¹⁰

At the federal level, in the late 1700s, Congress enacted a protective tariff, one of a number of early pieces of economic legislation that has left an import/export tension embedded in American economic policy to this day:

Coal is extremely bulky, making it expensive to transport. In the colonial era, British merchants had transported coal to American ports free-of-charge as ballast for ships. The first federal tariff on imported coal dated from 1789 ... [and until 1842] the tariff remained at least 10 percent the price of foreign coal—more than enough to give domestic producers a major cost advantage.¹¹

Federal protection was critical in the coal industry's early days, but the real action was at the state level. After the discovery of anthracite in



Early American anthracite miners
Source: U. of Toledo Professor Gregory Miller's Great Americans series¹⁴

Pennsylvania, "State officials exempted anthracite from taxation, provided incentives for smelters to promote its use, and publicized its advantages within and outside the state." Even more important than the industry's exemption from taxation was the state's use of corporate charters to encourage new production:

The Pennsylvania legislature carefully regulated the granting of corporate charters. To promote corporate mining ... the legislature permitted incorporation only in coalfields in which the industry had yet to become well established, designating the territory in which they could operate and the amount of capital they could raise.¹²

What began in Pennsylvania quickly spread:

Over time, states competed ever more vigorously to promote the production and consumption of coal—perpetuating a tradition of rivalistic state mercantilism that had been a pillar of state-sponsored public works programs in the early republic. ... For states that had yet to develop a coal industry, one common—and often effective—legislative stratagem was to sponsor a geological survey. In 1823, North Carolina hired a geologist to catalog the state's mineral resources; by 1837 fourteen states had followed North Carolina's lead. State geological surveys were at once scientific and economic: by inventorying the state's mineral resources, they would, or so legislatures hoped, identify rich deposits of precious metals—including coal. In Pennsylvania and Illinois, the legislature went so far as to instruct geologists to map the coalfields. ... [These] published survey reports contained valuable data that substantially lowered the cost of exploration.¹³

¹⁰ Sean Patrick Adams, *The Journal of Policy History* Vol. 18, No. 1, "Promotion, Competition, Captivity: The Political Economy of Coal" (2006).

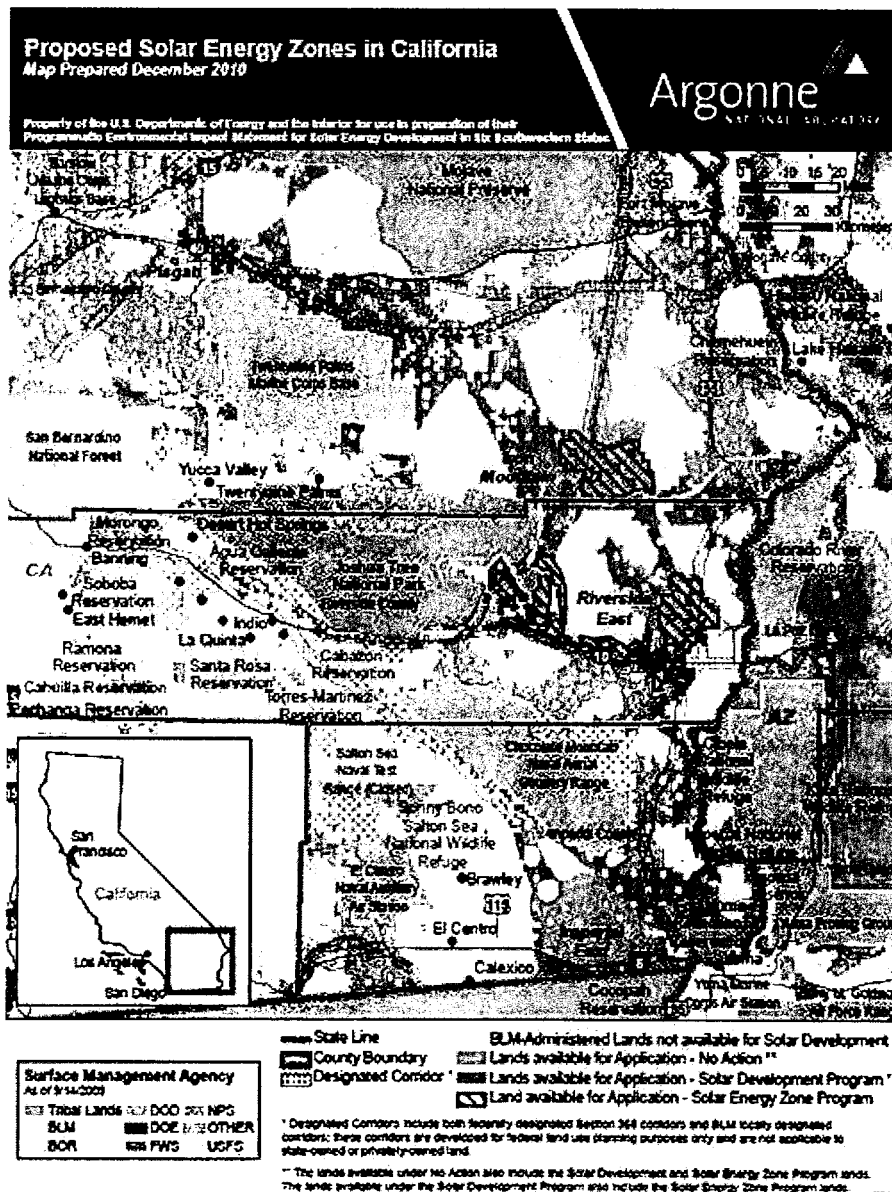
^{11, 12, 13} *Ibid.* Adams.

¹⁴ Available at <http://greatamericansclass.blogspot.com/2010/03/1902-anthracite-coal-strike.html>.

Government Land Surveys, from Coal to Solar

These early state-sponsored geologic surveys, intended to spur coal development, are not so different from today's attempts by the Department of the Interior to advance solar development:

The Interior Department has identified some two dozen potential sites for large-scale solar power installations on public lands in six Western states as part of an effort to encourage development of renewable energy on public lands and waters.¹⁵



¹⁵ John M. Broder, The New York Times, "Officials Designate Public Lands for Solar Projects" (Dec 16, 2010).

Early support for coal only grew as technology helped drive further demand for the fuel:

Following the Civil War, the railroads expanded tremendously. ... The trains themselves used a great amount of coal. Steam locomotives switched to coal from wood, which was starting to become less available and more costly in some areas. ... [In addition,] the Bessemer process for steelmaking ... made possible the large-scale, low-cost production of steel and greatly increased the demand for coal. Finally, the railroads made expansion of coal mining possible by providing the transportation network necessary for serving the expanding markets.¹⁶

It almost goes without saying, of course, that the transportation network created by the railroads would never have been possible without the same kind of federal land grants that so benefitted the timber industry. Any proper accounting of early government support for the coal industry must factor in these grants, which served to promote an exponential increase in coal consumption nationwide.

As the railroads grew, "The high price of coal and iron ... created a furor ... amounting almost to a mania, and the files of both houses [in Pennsylvania were] filled with bills for chartering new Coal and Iron Companies," according to a contemporary 1864 piece in the influential *Miners' Journal*. This craze was not unique to Pennsylvania, with newly discovered coal deposits driving the granting of corporate charters around the country.

Along with these charters, legislatures granted special rights to railroad companies that allowed them to vertically integrate so as to drive further coal production. In 1861, for example, "Pennsylvania granted railroads the ability to purchase the stocks and bonds of other corporations, a valuable concession they previously had been denied."¹⁷ In 1869 the legislature made explicit its intent in the 1861 bill by clarifying the right of railroad companies to invest in coal-mining corporations.

Since the end of the Civil War / Reconstruction Era, tremendous subsidies have continued to flow to the coal industry. However, since our aim in this paper is to discuss government subsidies to the various energy sectors in their early days, we will not return to a lengthy discussion of later government support for the coal industry. Suffice it to say, domestic coal did not arrive on the scene as a mature, low-cost and competitive fuel source. Rather, government support over many years helped to turn it from a local curiosity in Schuylkill County, Pennsylvania into the dominant fuel source of its time.

¹⁶ Op. cit. Cole, et. al.

¹⁷ Op. cit. Adams.

Categorization of 20TH Century Subsidies

As we turn from a qualitative account of 19th century subsidies towards a quantitative analysis of more recent federal support for the various energy sectors, it is useful to establish a framework of the different kinds of subsidies that have played a role in shaping today's energy infrastructure and markets. Management Information Services, Inc., a Washington D.C.-based economic research and management consulting firm, has provided a clear subsidy taxonomy that we lay out below:

A. Tax Policy

Tax policy includes special exemptions, allowances, deductions, credits, etc., related to the federal tax code.

B. Regulation

This category encompasses federal mandates and government-funded oversight of, or controls on, businesses employing a specified energy type. Federal regulations are an incentive in the sense that they can contribute to public confidence in, and acceptance of, facilities and devices employing a new or potentially hazardous technology. Federal regulations or mandates also can directly influence the price paid for a particular type of energy.

C. Research and Development

This type of incentive includes federal funding for research, development and demonstration programs.

D. Market Activity

This incentive includes direct federal government involvement in the marketplace.

E. Government Services

This category refers to all services traditionally and historically provided by the federal government without direct charge. Relevant examples include the oil industry and the coal industry. U.S. government policy is to provide ports and inland waterways as free public highways. In ports that handle relatively large ships, the needs of oil tankers represent the primary reason for deepening channels. They are usually the deepest draft vessels that use the port and a larger than-proportional amount of total dredging costs are allocable to them.

F. Disbursements

This category involves direct financial subsidies such as grants. An example of federal disbursements is subsidies for the construction and operating costs of oil tankers.¹⁸

This taxonomy is quite helpful in laying out the complete universe of subsidies that we could potentially explore. Many of these subsidies, however, are quite difficult to measure, and a lively debate exists in the NGO and academic literature about which should fully count as subsidies to the energy industry. Let's look at a few examples:

One of the key factors in bringing natural gas to the East Coast was the conversion to natural gas of the Big Inch and Little Inch oil pipelines, which had been built during World War II as means of bringing crude oil to the East Coast without fear of German submarine attack.¹⁹

¹⁸ Management Information Services, Inc., prepared for The Nuclear Energy Institute, "Analysis of Federal Expenditures for Energy Development" (September 2008).

¹⁹ Op. cit. Cole, et. al.

How should one value this contribution to America's natural gas network, which clearly acts as an ongoing subsidy to gas despite its original, defense-related purpose?

Sticking with natural gas, consider the development of the combustion turbine:

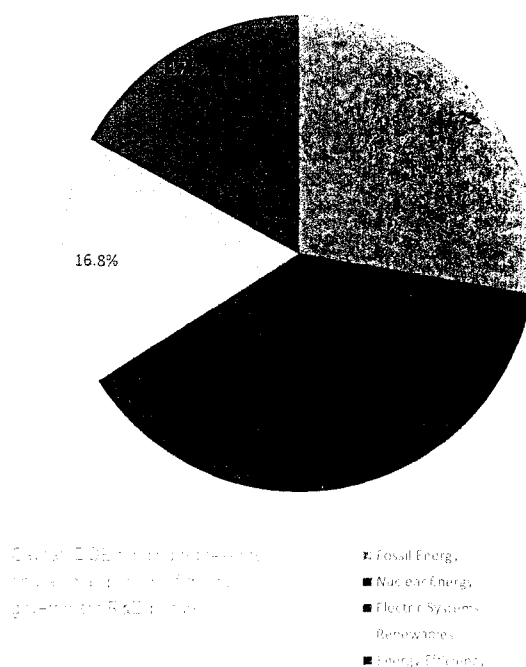
Its pedigree traces back to jet engines. For decades, utility managers found generating units based on jet technology cheap, but inefficient and unreliable. Largely through government-funded R&D on combustion turbines for aircraft use, the technology improved. Reportedly, the Defense Department invested an average of \$425 million per year in jet engine R&D from the mid-1970s to the mid-1980s, reaching \$750 million annually in the late 1980s. In the 1990s, the independent power sector used these cheap, effective, government-enabled "aero-derivative" turbines to challenge the dominance of established utilities.¹⁷

Of the hundreds of millions of dollars spent by the government developing these turbines, how much—if any—should be charged to the natural gas subsidy account?

Of course, just to look at the renewable side of the equation, there is a long history of NASA research and development money supporting solar energy technologies, as well. Management Information Services estimates that from 1950–2006, NASA spent nearly \$1 billion (in 2010\$) on R&D devoted to solar. While significantly smaller than the hundreds of millions of dollars spent annually on combustion development, this early government support for solar was nonetheless critical to the technology's eventual commercialization.

According to the Congressional Research Service, "For the 63-year period from 1948 through 2010, nearly 12% [of DOE R&D spending] went to renewables, compared with 9% for efficiency, 25% for fossil, and 50% for nuclear."¹⁸ The chart below shows the breakdown for the most recent 10-year period of our history. But since this graphic fails to account for the spillover benefits of Department of Defense or NASA R&D spending, it clearly gives us only a small portion of the full R&D picture.

DOE Energy Technology Share of Funding, FY2001–FY2010



¹⁷ *ibid.*, 10–11.

¹⁸ Congressional Research Service, "DOE Energy Technology Share of Funding, FY2001–FY2010," *CRS Report for Congress*, R44001, February 10, 2011, <http://www.crs.org/docdoc/otherdocs/energy/44001.pdf>.

The challenge of determining what subsidies to include is not simply about parsing historical data appropriately. Even today, a wide variety of ongoing subsidies to every sector of the energy industry might merit inclusion in our study, including many that are hot-button items. For example, a recent article in the New York Times lays out existing oil and gas loopholes that are currently under fire:

More than \$12 billion [in government savings] would have come from eliminating a domestic manufacturing tax deduction for the big oil companies, and \$6 billion would have been generated by ending their deductions for taxes paid to foreign governments. Critics suggest that the [oil and gas] companies have been able to disguise what should be foreign royalty payments as taxes to reduce their tax liability.²²

This is certainly contested terrain. The domestic manufacturing tax deduction applies to many companies—not just the major O&G players—so is it fair to count something so generally applicable against their subsidy scorecard? Perhaps, but the oil and gas industry would certainly argue not. Similarly, the fight about “dual capacity” taxpayers and foreign royalty payments is far from cut-and-dried. The current tax treatment is clearly beneficial to the oil and gas industry, but does it count as a subsidy, or is it simply an appropriate method of avoiding double taxation? This is complicated stuff, so in the following section, we do our best to lay out the boundaries of our own study, in an effort to be transparent and to demonstrate that the historical comparisons we are making are as close to “apples-to-apples” as possible.

22 Carl Hulse, The New York Times, “Senate Refuses to End Tax Breaks for Big Oil” (May 17, 2011).

Key Historical Subsidies by Sector

In researching this paper, we took a very practical approach to data collection, asking ourselves four questions:

- 1 Was a given subsidy actually designed to increase domestic production of a given resource (or does it do so in practice, even if that was not its original intention)?
- 2 Was the data related to that particular subsidy available?
- 3 Did the subsidy exist during the early stages of a resource's domestic production?
- 4 Did inclusion of that subsidy increase our ability to compare subsidy levels across resources and over time?

Let us look at the Low Income Home Energy Assistance Program (LIHEAP) as an example of a subsidy not included in our calculus.

- 1 No, LIHEAP is not specifically designed to increase domestic production of any given fuel resource. It is questionable as to whether or not the extra dollars that LIHEAP injects into the energy market actually increase production, or simply redistribute consumption.
- 2 Yes, the data on LIHEAP is available.
- 3 No, LIHEAP is a more recent program than some of the resources that it subsidizes (i.e. oil and gas), since it began in 1980.

- 4 No, LIHEAP actually diminishes our ability to make meaningful comparisons, since it potentially subsidizes multiple energy resources at differing levels. It is difficult to separate the subsidy's contribution to each source.

Having failed three out of our four necessary conditions for inclusion in this analysis, we left LIHEAP out of our subsidy calculus. Royalty relief for offshore oil leases in the Gulf of Mexico is another example: although clearly measurable and relevant to increased oil production, a subsidy created in 1995 does little to shed light on our historical understanding of early-stage oil and gas production in America. Similarly, many of the modern-day subsidies examined in excellent papers by the Environmental Law Institute, Earth Track, Friends of the Earth, and the Green Scissors Campaign, not to mention recent EIA reports on the subject, have no place in our paper, since we focus on historical subsidies that had an impact as a particular energy source emerged.

Rather than articulating all of the subsidies that we exclude from this analysis due to our need for clear and consistent boundaries, then, let us instead lay out how we actually have treated each of the major energy sources that have emerged over the last 100 years of American history:

Oil and Natural Gas:

We looked solely at the subsidies embodied in the expensing of intangible drilling costs and the excess of percentage over cost depletion allowance.

From the Congressional Research Service:

For more than half a century, federal energy tax policy focused almost exclusively on increasing domestic oil and gas reserves and production. There were no tax incentives promoting renewable energy or energy efficiency. During that period, two major tax preferences were established for oil and gas. These two provisions speed up the capital cost recovery for investments in oil and gas exploration and production. First, the expensing of intangible drilling costs (IDCs) and dry hole costs was introduced in 1916. This provision allows IDCs to be fully deducted in the first year rather than being capitalized and depreciated over time. Second, the excess of percentage over cost depletion deferral was introduced in 1926. The percentage depletion provision allows a deduction of a fixed percentage of gross receipts rather than a deduction based on the actual value of the resources extracted. Through the mid-1980s, these tax preferences given to oil and gas remained the largest energy tax provisions in terms of estimated revenue loss.²³

And from a 1990 report of the General Accounting Office:

... The marginal effective federal corporate tax rates—i.e., the tax rates on genuinely incremental investments—for domestic petroleum production are already among the lowest for a major industry, due to the effects of existing tax incentives. These analyses estimate marginal effective rates on petroleum production investments to be about half of the statutory rate for integrated producers (i.e., producers

with significant refining or retail activity). Marginal effective rates can be near zero for independent (i.e., nonintegrated) producers eligible for percentage depletion, a favorable tax treatment for depletable costs. These relatively low marginal rates already provide incentives to make petroleum production investments that have pretax returns below those of investments in other industries—i.e., relatively inefficient investments. Some petroleum production investments face negative marginal effective rates. This means that such investments are actually more profitable after taxes than before taxes because they help reduce taxes on other income.²⁴

**Authors' note: in 2009, domestic production of petroleum accounted for a little more than 40% of total U.S. consumption, and domestic production of natural gas accounted for more than 90% of total consumption.*

According to one analysis considering the impact of Reagan era tax reform on the oil and gas industry, "Effective tax rates on other industries average[d] about 28 percent under pre-1986 law, compared to rates on oil investments ranging from -6 percent to 24 percent under pre-1986 law."²⁵ Given the high profile of these two major tax expenditures, we felt on firm ground basing our analysis of oil and gas subsidies on this pair of long-lived government incentives. As one early researcher wrote, "Our findings reveal that several public policies significantly affected investment in crude petroleum reserves. ... Our empirical estimates support the position that the special federal tax provisions... have induced the petroleum industry to maintain a larger investment in proved reserves than it would have in the absence of these policies."²⁶

23 Molly F. Sherlock, CRS, "Energy Tax Policy: Historical Perspectives on and Current Status of Energy Tax Expenditures" (May 2, 2011).

24 Thomas J. McCool, et al., GAO, "Additional Petroleum Production Tax Incentives are of Questionable Merit" (July 1990).

25 Robert Lucke and Eric Toder, The Energy Journal Vol. 8 No. 4, "Assessing the U.S. Federal Tax Burden on Oil and Gas Extraction" (1987).

26 James C. Cox and Arthur W. Wright, Studies in Energy Tax Policy, "The Cost-effectiveness of Federal Tax Subsidies for Petroleum: Some Empirical Results and Their Implications" (Brannon, ed. 1975).

Take it from an even more storied source: “In 1937, President Franklin Roosevelt declared that percentage depletion was ‘perhaps the most glaring loophole in our present revenue law.’”²⁷

Coal:

The Green Scissors Campaign is a 15-year old effort “to make environmental and fiscal responsibility a priority in Washington,” sponsored by a variety of D.C.-based public interest groups. In their 2010 report, the Green Scissors analysts make the claim, “Subsidies to the coal industry began in 1932, when the federal government first began allowing companies to deduct a portion of their income to help recover initial capital investments (the percentage depletion allowance).”²⁸ Of course, what they mean is that modern, income tax-based subsidies began in 1932. Those who have made it this far in this paper already know that both the federal government and the various states heavily subsidized coal in the 19th century. But since we do not have access to data quantifying the coal subsidies that go back to the fuel’s true origins in the early 1800s, we have chosen not to include coal subsidies in our comparative quantitative analysis.

Nuclear:

In considering how best to quantify nuclear data, we considered multiple sources and decided to use the analysis conducted by lifelong energy analyst and consultant Marshall Goldberg, a resource

planner with a broad background in resource and land use policy and impact analysis. In his work, Goldberg includes principally the costs of regulation, civilian R&D, and liability risk-shifting (the Price-Anderson Act), while also taking into account both payments from the government to industry and government receipts from industry—thus coming up with a net annual figure for every year from 1947 to 1990. Although “on-budget” expenditures for the nuclear industry have been enormous, we especially value Goldberg’s analysis because he attempts a rigorous quantification of the “off-budget” value of the Price-Anderson Act of 1957, which “provided federal indemnification of utilities in the event of nuclear accidents, thus removing a substantial (and perhaps insurmountable) barrier to nuclear power plant development.”²⁹

Congressional testimony at the time of passage confirms the importance of Price-Anderson:

For instance, the Edison Electric Institute noted “We would...like to state unequivocally that in our opinion, no utility company or group of companies will build or operate a reactor until the risk of nuclear accidents is minimized.”³⁰

27 Mona Hymel, Loyola University of Chicago Law Journal Vol. 38, No. 1, “The United States’ Experience with Energy-Based Tax Incentives: The Evidence Supporting Tax Incentives for Renewable Energy” (Fall 2007).

28 Autumn Hanna and Benjamin Schreiber, the Green Scissors Campaign, “Green Scissors 2010” (2010).

29 Op. cit. Komanoff Energy Associates.

30 Op. cit. Goldberg.

Hydro:

Measuring subsidies to big hydro is a beast of a task, and there is broad disagreement about what analysts should and should not include as a subsidy. Management Information Services estimates about \$80 billion in historical federal subsidies to hydroelectric power, with nearly three quarters of that total coming from their “market activity” category:

Market activity incentives for hydroelectric energy include federal construction and operation of dams and transmission facilities—estimated as the portion of the net investment in construction and operation of dams allocated to power development and the relevant transmission facilities—and the net expenditures of the power marketing administrations.³¹

On the other hand: Data on early expenditures for hydropower are incomplete. This reflects both the scarcity of archived generation and investment data on hydropower—the development of which began in the 1890s—and the complex historical context of federal hydropower development. In particular, federal hydropower facilities often formed part of larger projects with multiple goals, including flood control, river navigability, regional development, and stimulation of the local and national economies. ... For instance, most of the spending on hydropower projects undertaken by the U.S. Army Corps of Engineers and the Bureau of Reclamation in the 1930s and 1940s was considered supplemental to the primary purpose of building dams for irrigation, flood control, and public water supply, among other uses. ... For this reason, it is difficult to attribute a specific portion of federal investment for power generation. Nevertheless, to assist in further investigations, the figure of \$1.6 billion can be given for a set of straightforward subsidies to hydropower.³²

This \$1.6 billion figure (\$2.7 billion in 2010 dollars) comes from an analysis by Doug Koplow of Earth Track, a respected think tank that works to consolidate and standardize energy subsidy data and present a comprehensive view of such subsidies so that we can better evaluate them. Koplow arrives at his \$1.6 billion figure by analyzing the implicit borrowing subsidies provided to the Tennessee Valley Authority, the Bonneville Power Administration, and the other Power Marketing Administrations by the federal government over an 80-year period, thanks to their ability to access capital at lower-than-market rates.³³

However, even with a rigorous analysis such as Koplow's, hydro data remains unsatisfying. For example, consider the fact that large hydroelectric facilities are essentially wholly owned subsidiaries of the federal government: thus, they do not need to earn private sector rates of return and can price electricity more cheaply than they otherwise would. This is clearly an important subsidy, but it is also an incredibly challenging one to measure. In the end, then, since hydro does not lend itself to facile comparisons with privately owned energy resources, we decided to exclude historical hydro data from our quantitative subsidy analysis. For those who want to dig more deeply into the subject, we recommend the analyses by both Koplow and Management Information Services, since the two follow vastly different approaches to calculating federal support for hydroelectric power.

³¹ Op. cit. Management Information Services.

³² Op. cit. Goldberg.

³³ Douglas N. Koplow, The Alliance to Save Energy, “Federal Energy Incentives: Energy, Environmental and Fiscal Impacts” (April 1993).

Biofuels:

Often, when comparing current energy subsidies, the conversation breaks down into a “fossil fuels vs. renewables” debate, with little thought given to the diversity of energy sources contained within each of those categories. Thus, using data from the Joint Committee on Taxation, the Treasury, and annual OMB analytical reports, we have broken out federal support for biofuels from those incentives designed to support increased wind, solar, and geothermal energy production. Our comparison takes into account both the income tax credit for alcohol fuels and the excise tax exemption for alcohol fuels, including that exemption’s more recent transition to a credit:

Beginning in 2005, the volumetric ethanol excise tax credit (VEETC) was introduced to replace the previously available excise tax exemption for ethanol. Since excise tax credits are deductible, replacing the excise tax exemption with an excise tax credit has additional federal revenue consequences, above and beyond payouts for the excise tax credit. Specifically, income tax receipts decrease due to the higher excise tax deduction.³⁴

Some biofuels subsidy analyses have also included Department of Agriculture support for farmers that has incented the growing of corn for ethanol. As the Environmental Law Institute points out,

A substantial portion of USDA’s corn production subsidy payments are received by farmers who use their corn to produce ethanol. Even though these subsidies are not directed at corn growers specifically for the purpose of producing ethanol, they

represent a government expenditure that benefits energy and that supports a specific fuel (and Congress has not acted to restrict the use of these subsidies in order to prevent them from supporting corn ethanol production).³⁵

Although this argument certainly has merit, the fact remains that these USDA subsidies are designed to stimulate the growing of corn, not the creation of fuel. The fact that some of this corn ends up as fuel is driven by the various alcohol tax incentives, federal blending requirements, and the price of traditional fossil fuels at any given moment in time, not by USDA grants. We have not included these USDA grants in our biofuels accounting.

Renewables:

Finally, we categorize renewables subsidies as those tax subsidies—principally, the production tax credit, as well as the investment tax credit—that incent power generation from wind, solar, and geothermal sources. Although some minor incentives became law in the late 1970s, significant federal support did not take hold until after the Energy Policy Act of 1992. Thus, we begin our accounting of renewables subsidies in 1994, when the first firms really took advantage of that 1992 law:

Section 45 of the IRS code, enacted in the Energy Policy Act of 1992, provided for a production tax credit of 1.5¢ per kWh (indexed) of electricity generated from wind and closed loop biomass systems. The tax credit has been extended and expanded

³⁴ Op. cit. Sherlock.

³⁵ Adenike Adeyeye, et. al, Environmental Law Institute, “Estimating U.S. Government Subsidies to Energy Sources: 2002-2008” (September 2009).

over time and currently is available for wind, closed-loop biomass, poultry waste, solar, geothermal and other renewable sources. Firms may take the credit for ten years.

Nonrefundable investment tax credits for alternative energy were initially put in place in the Energy Tax Act of 1978 (PL 95-618) at a rate of 10% for solar and geothermal property. That law provided a number of investment tax credits including a credit for residential energy conservation investments. This latter credit expired in 1982. [The Energy Policy Act of 2005] increased the investment tax credit for solar to 30% [extended through 2016 as part of the Energy Improvement and Extension Act of 2008].³⁶

In closing out this section, it is worth noting that the American Recovery and Reinvestment Act of 2009 included a host of temporary clean energy subsidies (many focused on energy efficiency and research and development, although some specifically targeted towards increasing renewable energy production). These temporary provisions do not fall within the scope of this paper, but we do recommend their inclusion in future longitudinal analyses.

³⁶ Gilbert E. Metcalf, MIT Joint Program on the Science and Policy of Global Change, "Federal Tax Policy Towards Energy" (January 2007).Z

Some Thoughts on Scope—Other Important Pieces of the Puzzle

State Level Subsidies

We do not include state level subsidies in our comparative analysis, although they are clearly important in shaping the market for both renewable and fossil fuel energy sources. Thus, in order to ensure that we were not unfairly tilting the playing field in favor of renewables by excluding state renewable portfolio standards from our analysis, we did a few quick calculations:

Lawrence Berkeley National Laboratory has conducted a number of studies to evaluate the costs of various state RPS policies. LBNL's figures suggest that the median rate increase due to the introduction of RPS policies around the country is about 0.05 cents/kWh at the retail level,³⁷ or about \$1 billion in additional costs per year across the 50% of U.S. electricity load governed by RPS policies, given current EIA estimates of about 3,700 billion kWh/year in total electricity usage.

We also considered a study conducted by a recent graduate of the Nicholas School of the Environment at Duke University, which found

that the 20-year net present value of future rate increases due to North Carolina's RPS policy is about \$1.6 billion, assuming current technology and prices.³⁸ Starting with this figure, we then estimated North Carolina's share of our national electricity usage, again recognizing that RPS policies currently cover about 50% of our country's electricity load, and we came up with a national 20-year NPV of \$22.5 billion, or a little more than a billion dollars per year.

Now, according to the Texas Comptroller of Public Accounts, the State of Texas offered about \$1.1 billion in severance tax incentives to the state's oil and gas industries in 2006.³⁹ Even assuming that Texas is the only state providing subsidies to the fossil fuel industry (which is certainly not the case), the equivalency of this billion-dollar annual figure to the size of the RPS subsidies gave us comfort that leaving out state subsidies was not unfairly biasing our analysis in favor of renewables.

37 Cliff Chen, et. al, Renewable and Sustainable Energy Reviews Vol. 13, "Weighing the Costs and Benefits of State Renewable Portfolio Standards in the United States: A Comparative Analysis of State-Level Policy Impact Projections" (2009).

38 Ting Lei, Master's project for the Nicholas School of the Environment at Duke University, "A Cost Impact Analysis of the Renewable Energy and Energy Efficiency Portfolio Standard for Investor-Owned Utilities in North Carolina" (May 2011).

39 Susan Combs, Texas Comptroller of Public Accounts, "The Energy Report 2008" (2008).

Some Thoughts on Scope—Other Important Pieces of the Puzzle

Durability

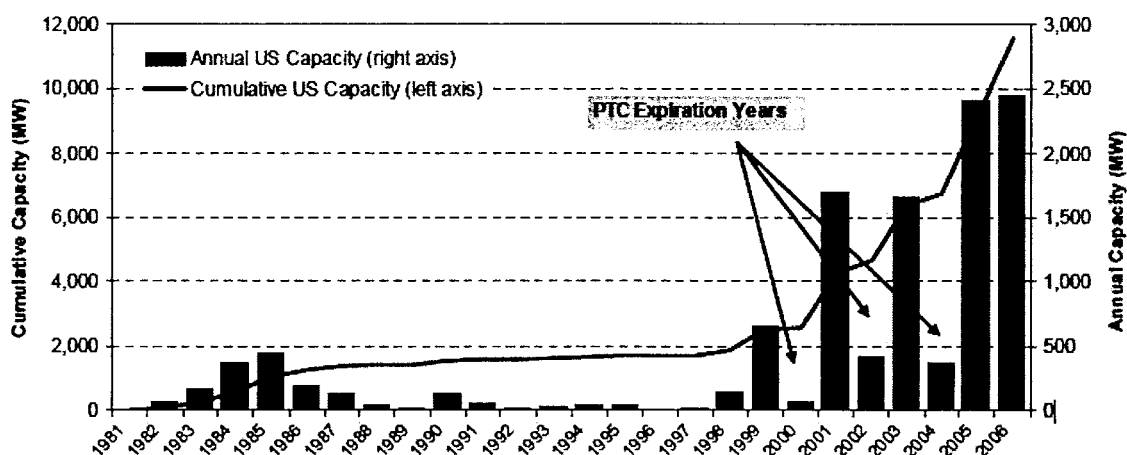
Not included in this study are the effects of the duration of various government subsidies, but to put it bluntly, policy certainty matters a great deal:

Some energy incentives, like the depletion allowance for oil and gas, are permanent in the tax code. Wind energy's primary incentive, the PTC, has been allowed to expire multiple times since its creation in 1992, and has been consistently reinstated for only one or two year terms.⁴⁰

Due to the series of shorter-term, 1- to 2-year PTC extensions, growing demand for wind power has been compressed into tight and frenzied windows of development. This has led to boom

and bust cycles in renewable energy development, under-investment in manufacturing capacity in the U.S., and variability in equipment and supply costs. Recent work at Lawrence Berkeley National Lab suggests that this boom-and-bust cycle has made the PTC less effective in stimulating low-cost wind development than might be the case if a longer term and more stable policy were established.⁴¹

Similarly, uncertainty regarding the near expiration of the renewable energy investment tax credit in 2008 almost single-handedly handcuffed new growth in the solar industry, before Congress renewed the credit at the last minute.



Source: Wiser Senate Testimony

⁴⁰ American Wind Energy Association, "U.S. Energy Subsidies" (May 2010).

⁴¹ Ryan Wiser Testimony before the U.S. Senate Finance Committee, "Wind Power and the Production Tax Credit: An Overview of Research Results" (March 29, 2007). Wiser is a staff scientist at Lawrence Berkeley National Laboratory. He leads and conducts research in the planning, design, and evaluation of renewable energy policies, and on the costs, benefits, and market potential of renewable electricity sources.

Some Thoughts on Scope—Other Important Pieces of the Puzzle

“Minor” tax considerations

Sections of the tax code exist that one would most likely never look at to find energy subsidies, but, nonetheless, they often turn out to be critical. Not included in this study are provisions like the following:

Developers of wind farms and solar power plants have begun lobbying for legislation that would let them form master limited partnerships, a financial structure used by pipeline operators, drillers and mine operators, as well as private-equity companies such as KKR and Blackstone ... that pay no corporate taxes, passing tax liability directly to investors. Eliminating the corporate tax burden increases the potential profit of master limited partnerships and makes them appealing to wealthy investors. *The tax vehicles were responsible for building much of the U.S. oil and gas pipeline networks.*⁴² [italics added]

One might think that what’s good for the goose should be good for the gander in terms of energy subsidies. Our research has revealed, however, that traditional fossil fuel sectors benefit from a host of older policies that the government has never extended to newer renewable forms of power generation, such as the master limited partnership provision cited here.

Defense Spending: Billions are so... civilian

Earlier in this paper, we briefly touched on the Department of Defense and NASA R&D spending that has benefited different energy technologies. But because so much of our current energy subsidy debate centers on the question of “energy security,” we felt that it was worth finding out if someone has attempted to quantify how much of American defense spending—outside of R&D money—subsidizes our energy consumption (even if we do not include those numbers in our own comparative analysis):

An innovative approach comes from Roger Stern, an economic geographer at Princeton University who published a peer-reviewed study on the cost of keeping aircraft carriers in the Persian Gulf from 1976 to 2007. Because carriers patrol the gulf for the explicit mission of securing oil shipments, Stern was on solid ground in attributing that cost to oil. He had found an excellent metric. He combed through the Defense Department’s data ... and came up with a total, over three decades, of \$7.3 trillion. Yes, trillion.⁴³

⁴² Bloomberg New Energy Finance, “Wind Power Wants U.S. Tax Advantage Used by Oil Companies” (July 19, 2011).

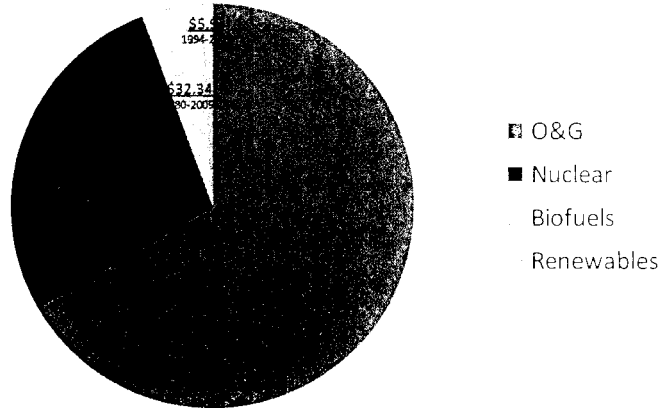
⁴³ Peter Maas, Foreign Policy, “The Ministry of Oil Defense” (August 5, 2010).

Findings and Analysis

Finally, we come to the heart of this effort—our quantitative analysis of historical federal subsidies to the energy sector.⁴⁴ Let's start with an overview of cumulative subsidies:

Cumulative Historical Federal Subsidies

2010\$, BILLIONS



The chart above is illuminating in demonstrating the historical magnitude of oil and gas and nuclear subsidies, but it does little to facilitate useful longitudinal comparisons. Thus, we turn to the chart below, which shows the average annual subsidies to each sector over their lifetimes.

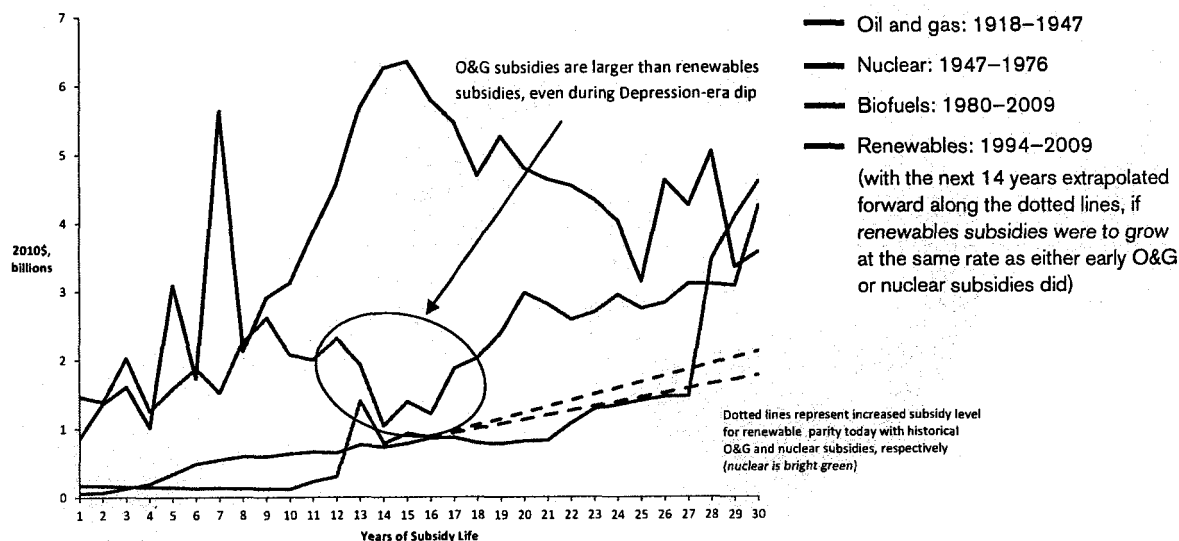
Historical Average of Annual Energy Subsidies: A Century of Federal Support



⁴⁴ See Appendix F for a breakdown of this section.

Of course, what we are really trying to understand in this paper are the subsidy levels to the various energy sectors during the early days of those subsidies, as new fuel sources have emerged. The chart below tracks the actual dollar subsidies to each sector during the first 30 years of those subsidies' existence:

Comparison of Early Federal Subsidies to Energy Sectors



Looking at the jagged changes in year-over-year subsidy levels displayed in the chart above, it is probably worth noting here that most of the subsidies analyzed in this paper do not take the form of a specific legislative appropriation, which one might expect would be smoother over time. Instead, tax expenditure subsidies, for example, rise and fall according to how effectively the private sector takes advantage of them in a given year. Similarly, an off-budget subsidy such as the risk-shifting embodied in the Price-Anderson Act corresponds to the number of new nuclear plants coming online in any given year.

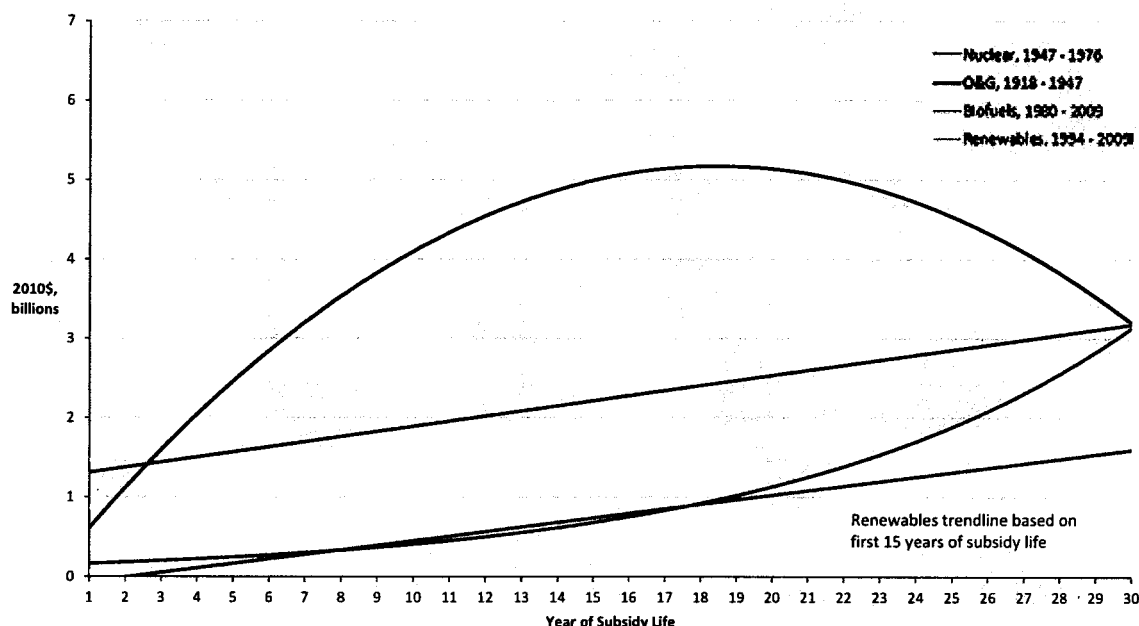
Some key points jump out from the chart above:

- Early subsidies to the nuclear industry dwarf all others;
- Biofuels subsidies rose linearly for most of their lifetime but jumped enormously due to policy changes in the mid-2000s;
- Renewable subsidies trail all others by a significant margin, with the lone exception being the 2006 jump associated with the temporary reauthorization of the production tax credit.

However, even that high-water mark barely equaled the lowest subsidy years during the early days of oil and gas subsidies (which occurred due to falling production during the Depression).

The yearly ups and downs of the chart on the previous page make it somewhat hard to read. Below is a version of the same data, smoothed out via 30-year trend lines. Here, the point jumps out even more starkly: renewable subsidies constitute only a small percentage of the subsidies received by both the oil and gas and the nuclear industries in their early days, in inflation-adjusted terms.

Comparative Energy Subsidy Trends



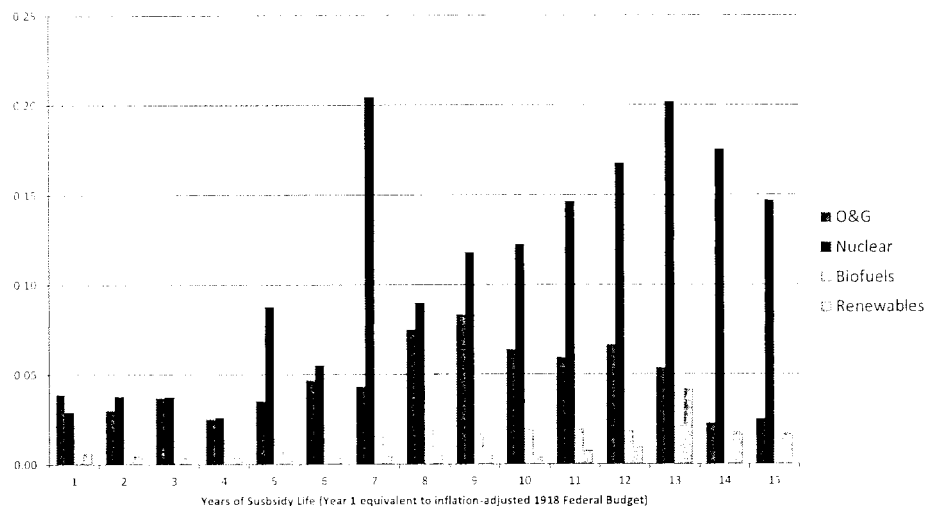
Now, on the following page is a chart that requires some explanation. If the federal budget is a reflection of spending priorities, then it would be useful to see what percentage of the federal budget various energy subsidies constituted during their early days. However, it would not be fair to compare oil and gas subsidies in 1918 to renewable subsidies in 1994 as a percentage of the budget, since the federal budget has grown so much larger due to new spending on everything from defense to agriculture to Medicaid.

What we've done, then, is taken the 1918—1932 federal budgets (which represent the first 15 years of federal oil and gas subsidies) and brought them forward in time to overlap with the introduction of subsidies to the other energy sectors. That is to say, when you look at the chart on the following page, you're looking at inflation-adjusted budgets for the years 1918—1932, absent any other increases in federal spending. Thus, you can actually get an apples-to-apples comparison of how the subsidies stack up with one another in terms of federal support.⁴⁵

⁴⁵ For example, the first tax expenditures for oil and gas occurred in 1918. We took the 1918 federal budget (year 1 for oil), and adjusted it for inflation to 1947 (year 1 for nuclear), to 1980 (year 1 for biofuels), and to 1994 (year 1 for renewables). We then did the same for each of the 1919-1932 federal budgets.

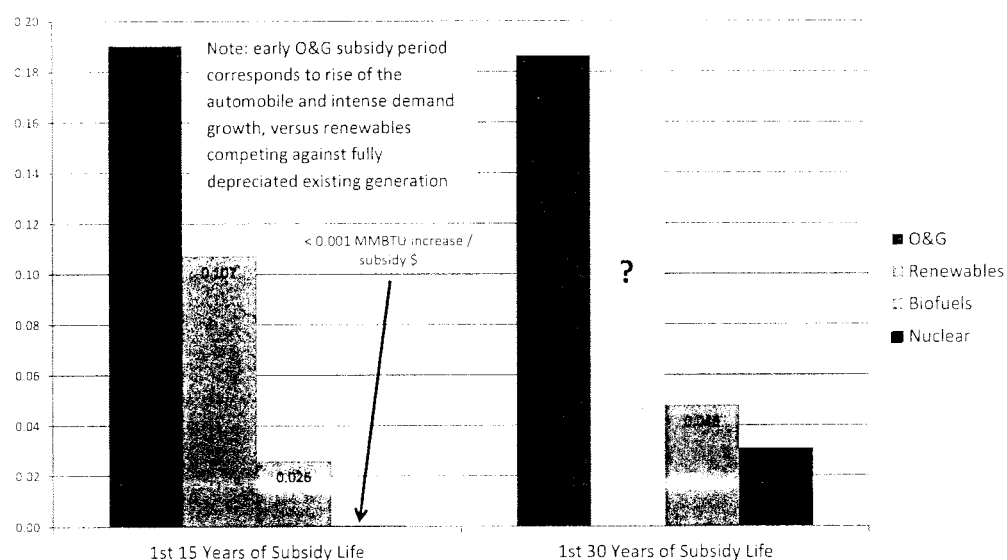
Once again, federal support for the nuclear industry overwhelms the other subsidies. Still, it is just as striking to compare the levels of support received by the oil and gas and renewables sectors. Oil and gas support never falls below a level at least 25% higher than renewables, and in the most extreme years, that support is nearly 10 times as great. This is a striking divergence in early federal incentives.

Energy Subsidies as Percentage of Federal Budget



Now, let us turn to the chart below: it examines the year-over-year increase in MMBTUS from a given energy source per subsidy dollar. It demonstrates that when seen from an incremental perspective, oil and gas production seems to outperform renewable production on an MMBTU / \$ basis during the industry's early days.

Increase in MMBTUs Produced / \$ in Subsidy



Nonetheless, it is worth considering why this may have been the case: with oil and gas, we are analyzing a period in time (the 1920s) when the rise of the automobile was driving intense demand for oil, a fuel source with no substitute for that purpose. Producers were scrambling to keep up with skyrocketing demand, and it is unclear how much incremental supply the subsidies really incented. Looking at renewables, on the other hand, we are analyzing a set of emerging technologies competing in a commodity business (the provision of electrons) against fully depreciated coal, nuclear, and hydro facilities—all of which had also been subsidized, of course—on a grid not usually designed to support new entrants.

Keeping that perspective in mind, then, the fact that renewables have performed even half as well as oil and gas on an MMBTU / \$ basis should perhaps surprise and impress us. And with renewable energy technologies improving at a rapid rate, we certainly cannot predict what a 30-year comparison graphic might eventually look like.

Discussion—

Subsidizing Apple Pie: Are the Slices Getting Smaller?

The quantitative analyses presented in the previous section, along with the qualitative discussion of 19th century energy subsidies, demonstrate that not only are incentives a tried and true American approach to driving energy innovation, but also that current subsidies for renewable technologies make up a much smaller federal commitment than was made during previous transitions. Looking at the history of American energy subsidies, a strong case can be made that in order to drive the next generation of energy technology, the federal government needs to continue its support for renewables, in line with our historical commitments to innovation:

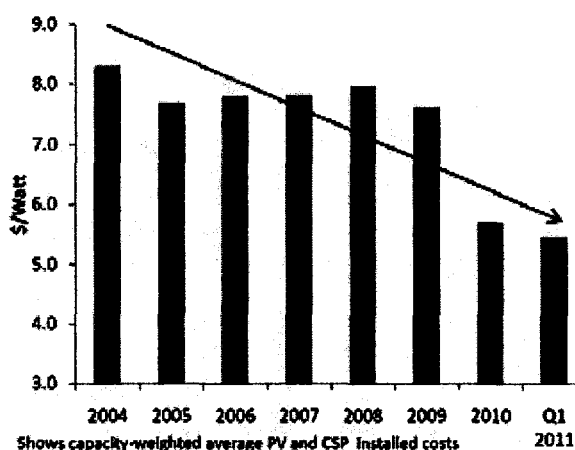
The energy industry's entrenched infrastructure is nearly impossible to compete with absent federal tax incentives. Such incentives were instrumental in overcoming the risk factor and establishing the current petroleum industry, and they are as necessary now for the alternative fuel businesses as they were 100 years ago to overcome high initial start-up costs, minimize the risk associated with new industries, and signal to taxpayers support for these industries.⁴⁶

Still, there is a chorus of voices in our current debate making the opposite point, as suggested in a recent USA Today opinion piece on electric vehicles (which could just as well apply to any other emerging energy technology):

The problem with electric vehicles can be summed up with one word: subsidies. Subsidies are prima facie evidence that consumers would not buy the product at its market price. Subsidies distort markets, compromising economic growth, and are simply wealth transfers.⁴⁷

This argument is intuitively appealing, no doubt. And for mature industries, it makes economic sense (without going into the issue of externalities and the potential need to price in environmental, social, or other consequences of a market transaction, which is a whole other question). But sticking to the purely economic perspective, consider the following recently published graphic:

Solar Average Installed Cost per Watt
2004 TO PRESENT



⁴⁶ Op. cit. Hymel (2007).

⁴⁷ Kenneth P. Green, USA Today, "Opposing view on energy: Subsidies? Just say no" (December 19, 2010).

As discussed earlier in this paper, combustion turbines were once uneconomic, and government support made them mainstream. That kind of innovation was surely a subsidy to the natural gas industry, but we can also agree that America as a whole is better off having access to the resulting technology. Why should current renewable technologies face different standards? Perhaps if they were unable to achieve technological and pricing breakthroughs, there would come a time when we should abandon support for them, but as the graphic on the previous page makes clear—stick with solar, and the price will continue to come down. We could chart the same price decline with wind technology, and who knows what will be next? To put the case succinctly:

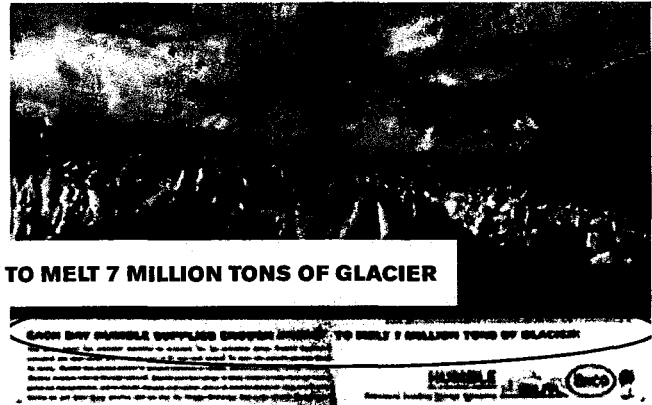
Some argue that incentives should be adjusted according to the maturity of the technology The idea is that increased use of the technology enhances technological change—with the most potential for technological improvement occurring in new technologies. This perspective may suggest that mature technologies such as those for fossil fuels should be subsidized less than those for renewable energy sources.⁴⁸

⁴⁸ Maura Allaire and Stephen Brown, Resources for the Future, "Eliminating Subsidies for Fossil Fuel Production: Implications for U.S. Oil and Natural Gas Markets" (December 2009). Allaire is currently a PhD candidate at the University of North Carolina at Chapel Hill. Brown is the Director of the Center for Business and Economic Research at the University of Nevada, Las Vegas.

Conclusion—

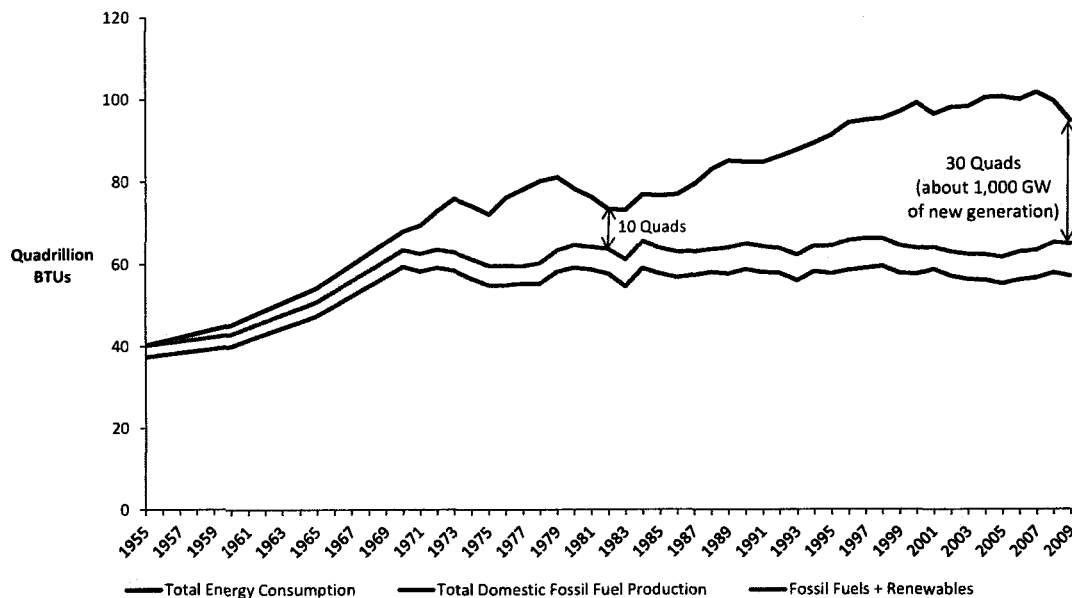
In Energy We Trust

In closing, we present the two images below, the first a 1962 *Life* magazine advertisement from Humble Oil (now Exxon Mobil) and the second a graphical representation of America's current dependence on foreign sources of energy.



Source: Koplow presentation⁴⁹

U.S. Energy Consumption vs. Production



Source: Energy Information Administration

⁴⁹ Douglas N. Koplow, OECD Expert Workshop on Estimating Support to Fossil Fuels, "Quantifying Support to Energy – Why is it Needed?" (November 2010).

Together, these two images demonstrate the fact—more clearly than we ever could in words—that America’s energy needs and priorities have changed over time, and that they will continue to evolve going forward, driven by economics, environmental concerns, and security issues. Throughout our history, energy incentives have helped drive critical innovation, speed U.S. economic transitions, and helped shape our national character. Today, as we seek to move towards a more independent and clean energy future, the truth is that renewables—from a historical perspective—are if anything under-subsidized. This weak support is inconsistent with our nation’s own historical energy narrative, which suggests:

Today's market for cheap power results in part from substantial investment by the federal government in innovative technology.

It takes a substantial amount of money, invested over several years, to bring an electricity generation technology to maturity.

Although energy subsidies can and do serve many policy purposes, the most basic relate to furthering the development and commercialization of technologies deemed to be in the public interest.⁵⁰

We titled this paper, “What Would Jefferson Do?” We believe that the answer to that question is now clear. He would do what our country has always done—support emerging energy technologies—to drive innovation, create jobs, protect our environment, enhance our national security in a time of rapid change, and to further a distinctly American way of life in which resources once thought to be endless are replaced by ones that actually are.

⁵⁰ Op. cit. Goldberg.

Appendix:

Data Sources

Consolidated data behind the charts in the “Key Findings” section are all on file with the authors and available upon request. A list of original data sources follows below:

- Energy Information Administration: Annual Energy Review 2009
- Energy Information Administration: Federal Financial Interventions and Subsidies in Energy Markets 2007
- Marshall Goldberg: “Federal Energy Subsidies: Not All Technologies are Created Equal” (July 2000).
- Doug Koplow: “Federal Energy Incentives: Energy, Environmental and Fiscal Impacts” (April 1993).
- Mona Hymel: “Americans and Their ‘Wheels’: A Tax Policy for Sustainable Mobility” (February 2006).
- The Joint Committee on Taxation: Background Information on Tax Expenditure Analysis and Historical Survey of Tax Expenditure Estimates (1980 – 2010).
- Department of Treasury: President’s Budget (1980 – 2010).
- Office of Management and Budget, Analytical Perspectives (1996 – 2010).